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Adapting or maladapting: Building resilience to climate-related disasters in coastal cities

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ABSTRACT

Despite the increasing risks associated with climate-related hazards, urban development in many coastal cities continues to take place on low-lying, high-risk land. Resilience is a key concept in adaptation, however, in the context of cities it is a complex phenomenon influenced by a diverse range of factors. This paper explores how the key elements of urban resilience (agents, institutions, and systems) interact to determine the types of approaches cities take to build resilience in two Australian cities. It uses case study data including semi-structured interviews with a diverse group of stakeholders ranging from local and state government authorities, non-government organisations, consulting firms, and researchers to the insurance industry. Findings indicate that the attitude of agents shapes the institutions and systems thus determining types of adaptation strategies in response to climate change. When the community's desire to live close to water couples with a lack of understanding or underestimation of the impacts, adaptation efforts are undermined. These findings call for a focus on the key role of agents for a transformational approach to building resilience that is based on shared learning.

1. Introduction

Climate change is expected to increase the duration, severity and/or frequency of climate-related hazards (Intergovernmental Panel on Climate Change [IPCC], 2007, 2012, 2014). Despite the increasing risks of a changing climate, urban development in coastal areas continues to take place on low-lying land that is vulnerable to hazards such as flooding, cyclones, and storm surges (Adger, Hughes, Folke, Carpenter, & Rockström, 2005; Small & Nicholls, 2003). These vulnerabilities are also exacerbated in cities that rely on the tourism industry (Becken & Hay, 2007). Local governments and communities around the world are at the forefront of climate change adaptation but they face major challenges (Schipper & Pelling, 2006). Enhancing urban resilience has become the main goal of adaptation plans and policies (Albers & Deppisch, 2013; Leichenko, 2011) but the ambiguity of the concept of resilience and the inherent complexity of cities make this goal difficult to achieve (Jabareen, 2013).

This paper tests a conceptual framework of urban resilience and explores the role of agents (actors such as the community and policy-makers), institutions, and physical systems in building resilience and adapting to climate change through a comparative case study of two low-lying coastal cities in Australia. The findings have important implications for many coastal cities around the world that face similar challenges. The next section provides a brief overview of the literature on adaptation and urban resilience. We then introduce the case studies and methodology. The paper concludes by exploring the adaptation approaches and interactions among elements of cities and discusses the implications for building resilience.

2. Adaptation to climate change: an urban resilience perspective

Adaptation is “the process of adjustment to actual or expected climate and its effects” that seeks to moderate or avoid harm and exploit beneficial opportunities (IPCC, 2014: 1785). Urban planning plays a critical role in adaptation through managing land-use and development (Davoudi, Crawford, & Mehmood, 2009; Eraydin & Taşan-Kok, 2013). Climate change poses challenges for conventional planning that is based on linear risk-based approaches (Davoudi et al., 2012). Managing the risks of climate-related hazards is usually addressed by building defence structures, accommodating impacts by incorporating measures such as mandating higher floor levels, or the retreat or relocation of settlements (IPCC, 2007; Macintosh, 2013). However, in the past planning has delivered outcomes that undermined adaptation (Howard, 2009). Hurlimann and March (2012) identified three key challenges: (1) developing conviction; (2) facilitating equitable processes and outcomes; and, (3) transforming planning systems from passive to proactive.

Despite its increasing importance, evidence of effective adaptation

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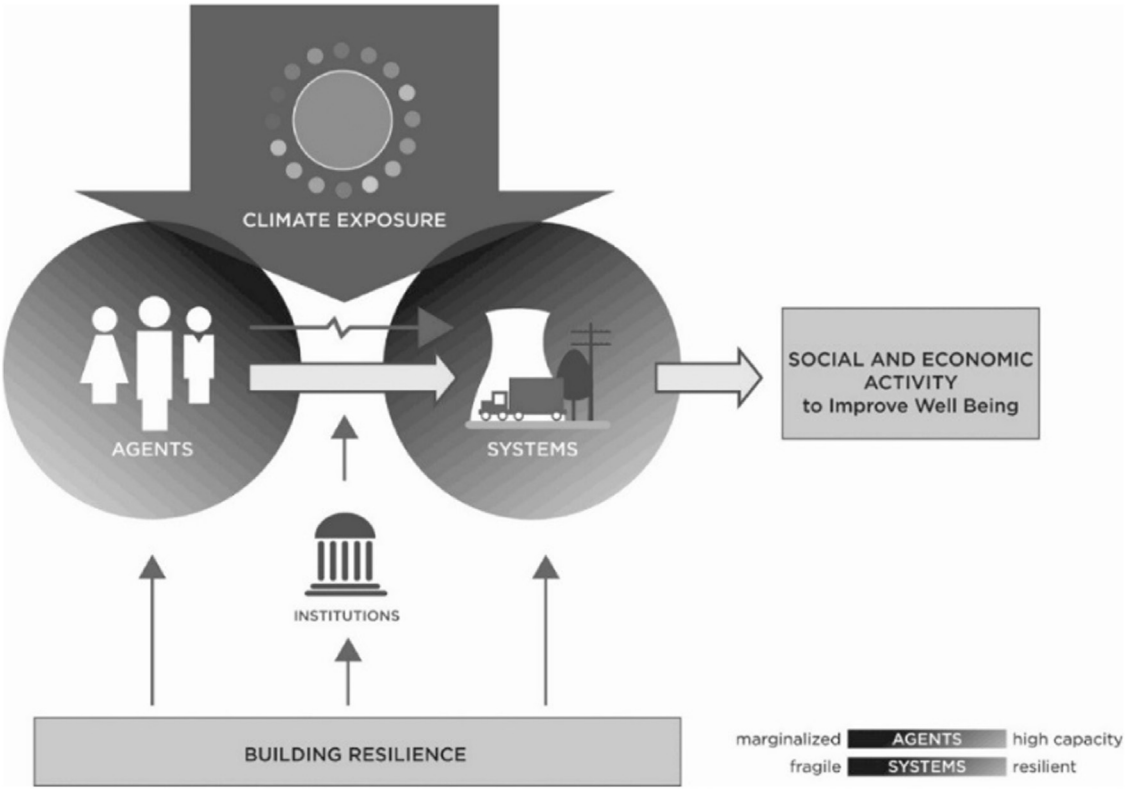

Fig. 1. Conceptual framework for urban climate resilience (Tyler & Moench, 2012: 319).

in developed countries is limited (Ford, Berrang-Ford, & Paterson, 2011). This is partly due to the ways cities have developed without any consideration of climate change (Magnan et al., 2016) and individual, cultural, institutional, and legal barriers (Moser & Ekstrom, 2010). Failed adaptation happens when a strategy has little or no effect on reducing risks (Jones, Carabine, & Schipper, 2015). Maladaptation occurs when actions intended to reduce risk and vulnerability have the opposite effect (Barnett & O'Neill, 2010; IPCC, 2014), undermining adaptive capacity (Magnan, 2014). Implementation of measures such as building sea walls, for example, requires high levels of funding and can lock in vulnerability in the long run by encouraging future development on high-risk areas (Organisation for Economic Co-operation and Development [OECD], 2014). Maladaptation in coastal cities can be rooted in diverse institutional and socioeconomic factors including the planning and land-use responses, insurance and compensation arrangements, or the interpretation of climate risks by individuals (Macintosh, 2013; O'Hare, White, & Connelly, 2015; Reser, Bradley, Glendon, Ellul, & Callaghan, 2012).

The notion of resilience has increasingly gained attention in disaster risk reduction as a more positive concept compared to vulnerability (Malone, 2009) by bridging the different phases of disasters (O'Brien & Read, 2005). Resilience has also become a popular concept to integrate climate change adaptation and disaster risk reduction (Howes, 2015). The evolution of the concept of resilience across different fields of study and mainly in ecology, led to three distinct notions of resilience: *engineering resilience* focusing on the persistence of relationships in a system to withstand change (Holling, 1973); *ecological resilience* as the magnitude of the disturbance that can be absorbed before the system changes its structure (Holling, 1996); and *socio-ecological resilience* as the capacity to change, adapt, and transform in response to shocks/disturbances (Carpenter, Westley, & Turner, 2005). Similarly, translation of the concept to urban studies has resulted in three main understandings of urban resilience as the ability of a city to withstand change and bounce back to a previous state, adjust to change and reorganise without changing existing structures, and adapt to change and transform by learning and innovation (Davidson et al., 2016). The latter is called *evolutionary resilience* (Davoudi et al., 2012). Despite its increasing use in planning policy and practice, resilience has become a fuzzy concept, or another empty signifier similar to sustainability (Davidson et al., 2016; Vale, 2014). There are many different and contrasting definitions of urban resilience ranging from resisting change or maintaining existing conditions by accommodating change to bouncing forth and transforming (Meerow, Newell, & Stults, 2016) that create complexities for practice. The concept also has different dimensions such as urban ecological resilience, hazards and disaster risk reduction, resilience of urban and regional economies, and urban institutional resilience (Leichenko, 2011), raising concerns about what aspect of resilience should be studied in urban research (Cutter, Burton, & Emrich, 2010; Vale, 2014).

Cities include complex social systems and networks of urban services (such as transport, housing, energy, jobs, health systems, and finance) that are closely linked to ecosystem services. Understanding the key elements of cities and their interactions can simplify their complexity and facilitate planning for urban resilience (Desouza & Flanery, 2013). Some scholars have developed conceptual frameworks to identify the key elements of cities (see Alberti et al., 2003; Meerow & Newell, 2016). For example, Tyler and Moench's (2012) urban climate resilience framework identified three key elements: agents, institutions, and systems. Enhancing the capacities of agents, reinforcing institutions, and strengthening physical systems are crucial for increasing resilience in this framework. *Agents* of an urban system are the key actors capable of purposive decisions, deliberate actions, and strategic choices that contribute to resilience through their ability to learn, resourcefulness, and responsiveness and include individuals, households, community, society, political actors, and organisations (Tyler & Moench, 2012). The urban *institutions* critical for resilience include policies, laws, social norms, etc. that influence the ways systems are used by agents, can foster learning and change, and contribute to building adaptive capacity (Adger et al., 2005; Tyler & Moench, 2012). Institutions mediate the interactions between agents and systems

(Moser & Satterthwaite, 2008). Urban *systems* including settlements, infrastructure systems, and ecosystem services that have characteristics such as flexibility and diversity, redundancy and modularity, and safe failure also contribute to resilience (Tyler & Moench, 2012).

Tyler and Moench (2012) show the key agents, institutions, and systems of the city that are critical for building resilience in Fig. 1. This framework brings together three key concepts of exposure, vulnerability, and resilience and argues that intervening with agents, institutions, and systems can reduce vulnerability and build resilience. Here, exposure to the impacts of climate change combined with existence of fragile systems, marginalised/low-capacity agents, and weak institutional support lead to vulnerability (darker sides of the circles). Resilience is enhanced when supportive institutions enable high-capacity agents to access flexible and robust systems (lighter sides of the circles). A reduction in vulnerability as a result of social and economic activity can improve well-being and build resilience. The interactions between agents, institutions, and systems are complex. Tyler and Moench (2012) highlight the importance of interlinkages between them and particularly the influence of institutions on agents (e.g. by constraining or enabling access to key systems) and the influence of agent capacities on systems (e.g. resourcefulness of organisations enabling funding for infrastructure operation). However, the nature of such interlinkages has been under-researched. This paper answers the research question "How do agents, institutions, and systems influence urban resilience to climate-related disasters?" with a holistic approach to urban resilience by focusing on these three elements and the interactions among them to determine the level of resilience.

3. Methodology

The research uses a comparative case study approach. Multiple sources of data including interview transcripts, archival records, newspaper articles, policies, and documentation were triangulated for the case studies (Tellis, 1997). Thirty-seven semi-structured interviews were conducted with key stakeholders including local and state government officials (excluding elected members), researchers, representatives from non-government organisations, the insurance industry, consulting firms, property development, and local media between February and August 2015 (see Appendix A). The stakeholders were selected based on their expertise across the two case study areas. The participants were recruited via purposive sampling technique (Patton, 2002) based on a list that was developed including major stakeholder categories. This was followed by sequential sampling to identify more participants relevant to each stakeholder category on the list. The snowball sampling began with the recommendations of the first group of respondents. However, to be able to capture stakeholders outside the social network of the first respondents and minimise any bias (Holstein & Gubrium, 2003), all key organisations on the stakeholder list were also contacted. This method worked well especially for those participants at the decision-making level who agreed to participate based on the recommendations of their colleagues or friends. The interviews were analysed and coded thematically (Kvale & Brinkmann, 2009). We also undertook a content analysis of relevant key local government policies (i.e. planning schemes, climate change adaptation plans, and disaster management plans) to evaluate their collective focus on resilience and adaptation (Torabi, Dedekorkut-Howes, & Howes, 2017a).

The resilience framework is applied to the Australian cities of the Gold Coast and the Sunshine Coast located in South East Queensland (SEQ) (see Fig. 2). The SEQ region has been identified as a climate vulnerability hotspot (Burton, 2014; Dedekorkut, Mustelin, Howes, & Byrne, 2010; IPCC, 2007). The 2011 Queensland floods, for example, led to 38 deaths, the inundation of 20,000 homes, and insurance pay-outs of A$2.4 billion (Productivity Commission, 2014), and were exacerbated by climate change (Ummenhofer et al., 2015). The Gold Coast and the Sunshine Coast have been among the fastest growing cities in Australia between 2001 and 2011 (Department of Infrastructure and Transport Major Cities Unit, 2010) and this growth continues unabated. There are many biophysical and socioeconomic similarities between the two cases including their policy context within the same state, geographical location on low-lying high-risk land in close proximity to water, and the nature of weather events that they are exposed to. Both cities have a lower percentage of population aged under 15, a higher percentage of population aged over 55, and higher internal migration rates compared to Australia and the capital city of the State of Queensland Brisbane (Australian Bureau of Statistics [ABS], 2011). They are also among the most popular locations in Queensland visited by both domestic and international visitors (Tourism and Events Queensland, 2014; Tourism Research Australia, 2011). The economy of both cities is reliant on similar and mostly tourism-related industries such as retail, health care and social assistance, construction, and accommodation and food services (ABS, 2011). However, the Gold Coast has a higher population density due to intense high-rise development along the coast and especially in Surfers Paradise (Dedekorkut-Howes & Bosman, 2015).

4. Approaches to building resilience on the Gold Coast and the Sunshine Coast

The approaches undertaken by governments worldwide in building resilience stretch along a spectrum from *coping* with change that aims at maintaining current ways of life by dealing with the impacts of individual disasters in the short-term (low resilience) and *incremental adaptation* that combines coping with short to medium-term strategies that work effectively up to a certain risk level, to *transformational adaptation* that adds long-term innovative approaches to change the existing ways of life and practices (high resilience) to the aims of the previous two approaches (European Environment Agency [EEA], 2016). Table 1 provides an overview of these three key approaches along a resilience spectrum in terms of what kinds of actions they involve and how they conceptualise change and uncertainty.

Zeppel (2012) has shown that climate adaptation plans of the Gold and Sunshine Coasts were both mainly focused on council governance (coping) as opposed to emphasising nature (transformational adaptation) or the community. We examined the approaches used in our cases based on the resilience spectrum and mapped our findings (Table 2). Overall, the results indicate that evidence of a transformational adaptation is very limited in both cities and current policy, practice, and ways of life mainly focus on coping and incremental steps with a limited and short-term focus. Comparatively, more incremental steps towards building resilience are undertaken on the Sunshine Coast as a result of the past experience of disasters, the historical settlement pattern that, unlike the Gold Coast, is set back from the coast, and the integration of resilience considerations in city policies.

4.1. Coping approaches to resilience

The coping approach to building resilience includes actions that support business as usual (e.g. continuing to develop vulnerable land) and/or deal with the impacts of climate-related disasters in the short-term and on a smaller scale (e.g. radio campaigns to raise flood awareness, putting sandbags in front of doors/windows or building a seawall or levy to control the existing flood levels). While coping approaches are easy to implement (as they apply known methods) and can be highly effective in managing the immediate risks, they are insufficient in managing future climate risks and can bear high costs of replacement (Lonsdale et al., 2015; Matyas & Pelling, 2015). Existing path dependencies in city infrastructure as a legacy of past planning decisions, institutional tools such as policies relevant to land development, funding, insurance arrangements, and the attitudes of the community and developers that are highly focused on continuing business as usual are among the main underpinnings of a coping approach in the

Fig. 2. Case study areas.
(Map courtesy of Mariola Rafanowicz, 2017).

case studies.

An important contributor to the vulnerability of many coastal cities worldwide in the face of climate-related disasters is the old age of infrastructure such as sewage, storm-water drainage, and roads in highly exposed areas that are usually constructed to serve smaller populations or built to outdated design standards (Queensland Floods Commission of Inquiry [QFCI], 2012). A pertinent example in the case studies is the path dependencies created by the transport network of the city. Almost all interviewees considered this to be a problem particularly for canal estates. A planning consultant (R27) suggested "Those areas can be very difficult to get in and out of and they become isolated pretty quickly". This is especially problematic on the Gold Coast where "We have far more water's edge than Venice and Amsterdam put together and we have canals along the river but […] we have 1% of the bridges that they have" (Architect R4). Yet such developments continue to get approved on the Gold Coast, although they are no longer an acceptable settlement pattern on the Sunshine Coast. Most interviewees also discussed the vulnerability of high-rise development and particularly the difficulty of evacuation on the Gold Coast's coastal strip due to high density of population. An ecology researcher (R9) suggested that "[high-rise buildings] probably won't function if surrounded during the flood but there is a period at the end of the flood that can be months, if you can't get that building up and going it is a huge problem". Moreover, many of the high-rise buildings in both cities, particularly on the Gold Coast where 18% of the dwellings are high-rise apartments (ABS, 2011), are tourist accommodation or retirement facilities which can add to the socioeconomic vulnerability. While local governments have been undertaking extensive upgrades to some of the infrastructure to manage flooding, these actions are not sufficient in the long-term.

Planning policies such as zoning regulations and setbacks to avoid high-risk areas are critical tools for local governments in managing risks and uncertainty (Chadenas, Creach, & Mercier, 2014; Eraydin & Taşan-Kok, 2013), however, some policy provisions relevant to rights and entitlements to develop land can limit local government action on climate change. For instance, in Queensland under the *Sustainable Planning Act 2009* and its relevant compensation policies, local governments can incur liability if they undertake any changes to the planning scheme (e.g. zoning regulations to include planning controls for flooding) that would require compulsory acquisition of part of a person's land (the 'acquisition of property on just terms' is also required under section 51(xxxi) of the Australian constitution). The importance of this issue has been discussed by the QFCI (2012) set up to examine the 2011 Queensland floods as well as researchers (Low Choy et al., 2012). Aside from liability issues, most local governments around the world are also grappling with the lack of necessary funding in responding to climate-related disasters (Bulkeley & Betsill, 2005; Measham et al., 2011; Productivity Commission, 2014). A representative of an intergovernmental organisation (R29) stated that "local governments don't have the money to communicate in great detail […] so it gets boiled down to really basic messages like 'clean up the yard' or 'secure loose items in the yard' or 'if it is flooded forget it'". Even when there is funding (from state or local governments), resilience actions can still be undermined

Table 1
Overview of the three key approaches in the climate resilience spectrum[a].

Level of resilience	Low ← → High		
Resilience approach	**Coping**	**Incremental adaptation**	**Transformational adaptation**
Definition	Coping with the consequences of disasters and change	Incrementally improving existing conventional measures	Transforming the way to address climate impacts in a broader and systemic way
Contributing actions	Actions aiming at restoring current way/quality of life after disaster (disaster risk management) and/or reducing disaster risk Rebuilding after each disaster and reactive management of change while focusing on current conditions	The extension of familiar actions that are normally taken to reduce losses or enhance benefits from climate variability and extreme events Doing more of the same to deal with current climate variability and extremes to keep the present system in operation	Questioning the effectiveness of existing measures Foreseen and planned management of change Addressing the root causes of vulnerability by using behaviour and technology Single initiatives or a series of rapid incremental changes in a particular direction to support transformation
Approach to "change"	Change is seen as high risk, builds on past experience to manage risk *High risk of maladaptation*	Change is seen as risk, uses known methods and increases their efficiency *Medium risk of maladaptation*	Change is seen as opportunity, explores alternative and innovative solutions *Low risk of Maladaptation*
Time horizon	Dealing with the immediate impacts of extreme events once they appear or when stresses become obvious (short-term)	Building on existing adaptation measures and knowledge gained by incrementally improving efficiency in short to medium-term.	Taking an integrative, innovative, and long-term view
Scale	Sectoral and local (little connection to larger scales)	Sectoral and local orientation (modest connection to larger scales)	System-wide or multi-system perspective
Examples	• Approving development in high-risk, flood-prone areas without any consideration of risks (Chadenas, Creach, & Mercier, 2014) • Emergency management and soft short-term measures such as awareness raising campaigns (EEA, 2016) • Infrastructure upgrade to existing standards or in the exact same location (Matyas & Pelling, 2015) • Existing planning instruments (zoning, setbacks, or building codes without a consideration of risks) (EEA, 2016) • Consideration of current levels of risk in planning (EEA, 2016)	• Inclusion of existing/short to medium-term risk levels to planning instruments (zoning, setbacks, building codes) (EEA, 2016) • Increasing capacity of mitigation infrastructure (e.g. raising sea walls from previous levels, or sewage capacity, dykes) (EEA, 2016; Matyas & Pelling, 2015) • Consideration of lower levels of risk (e.g. 1.5-2 ºC warming) (EEA, 2016)	• Incorporating uncertainty into decision-making (EEA, 2016) • Paradigm shift in infrastructure planning: promoting resilience attributes such as redundancy, decentralisation, diversity, etc. (Matyas & Pelling, 2015), Integrated infrastructural measures (integrated seawalls with land use change) (Kates, Travis, & Wilbanks., 2012) • Ecosystem-Based Adaptation (Wamsler, 2015) • Anticipatory learning (Tschakert & Dietrich,2010) • Sharing resilience knowledge between communities (Chang et al., 2015) • Preparedness for higher levels of change (e.g. 4-6 ºC)

[a] Based on Lonsdale, Pringle, and Turner (2015) and EEA (2016).

as a result of short-term thinking of governments. For example, although research extensively points to the benefits of appropriate disaster prevention as a better option (Godschalk, Rose, Mittler, Porter, & West, 2009; Pappenberger et al., 2015), in Australia there is still a strong focus on reconstruction. A representative from state (R33) criticised the national *Natural Disaster Relief and Recovery* funding arrangements for over-investment in disaster recovery as opposed to prevention and mitigation of impacts by comparing it to the Dutch model:

> "The Dutch have been dealing with resilience of their communities and dealing with flooding […] and they are quite surprised that 97% of our funding for recovery goes to reconstruction and 3% goes to mitigation and resilience. In their mind, it is completely turned around […] Very little is put aside for actually reconstructing damage to assets. The majority of the funding for natural disaster goes to mitigation spending and enhancing community and also infrastructure resilience."

Government reports have also brought to attention the disparity between mitigation and recovery expenditure in the Australian disaster funding as a barrier for adaptation to climate change (Productivity Commission, 2012).

Other examples of maladaptive coping actions include approval of development on high-risk land with very short-term disaster management solutions. A state engineering consultant (R30) noted that "things like caravan parks or holiday parks are often proposed to be located in areas that wouldn't normally be considered for normal residential development […] There is often a push to have that sort of development in these low-lying, vulnerable areas". Many interviewees also criticised the approval of a development in a high flood-risk area on the Gold Coast conditional to having boats (Fig. 3, Stephens, 2013). A planning consultant (R25) observed: "that just seems to be that […] Okay it is going to flood, here is your boat, good luck! […] It is not a solution. It is very short-term". An environmental law consultant (R26) pointed to the implications of this in the long-tem: "as that building gets older and older the tenants will be aged […] Eventually you will end up with an older building with a lot of retired people in there who are going to have a lot of trouble getting down the stairway let alone getting into a boat to escape". Yet, maladaptive development in high-risk areas conditional to such resilience measures as boat ramps and helipads are continuing on the Gold Coast (Emery, 2017).

The reliance on short-term coping solutions is partly due to the considerable economic burden more resilient adaptive actions place on households. A planning consultant (R14) criticised the Gold Coast's new *City Plan* that promotes future development on the city's highly exposed coastal strip for creating uncertainties around investment. A council planner (R12) pointed to community opposition and noted "people don't want to raise their house and necessarily not at their own cost". This can be a result of community perceptions of risk that influence decisions regarding the choice of settlements, individual protection measures such as insurance or public support for government risk reduction actions (Blaikie, Cannon, Davis, & Wisner, 2014; Slovic, 1987). Some interviewees attributed the lack of acceptance/awareness of risk to the difficulties in understanding the language of climate change, including thresholds such as the 1-in-100 year flood event. A coastal engineering researcher (R15) suggested that the communities think like "It's 2100. That is a long time. We've got at least 1-2 generations to get there". A council planner (R12) observed that "I think people have this expectation that […] if they are not in a flood area, then they are not flood affected. […] That is not entirely right, because you are affected by events greater than 1-in-100 or you can be affected by stormwater flooding". Council planners and engineers particularly on the Gold Coast suggested that such a lack of understanding of risks influences community's appreciation for disaster risk reduction policies, actions taken by local governments, or the costs involved. The lack of appropriate communication of risks combined with a lack of experience of disasters can create a false sense of security for the community that weighs risks usually over the lifetime of a mortgage (typically 30 years).

Table 2
Factors affecting resilience approaches on the Gold Coast and the Sunshine Coast.

Level of resilience in urban systems	Low → High					
Urban Resilience Approach	**Coping**		**Incremental adaptation**		**Transformational adaptation**	
	Gold Coast	Sunshine Coast	Gold Coast	Sunshine Coast	Gold Coast	Sunshine Coast
Urban agents						
Community						
- ***Desire to live close to water***						
- ***Lack of resources***						
- ***Difficulties in understanding the language of climate change***						
- ***Lack of past experience of significant climate events***						
Local government						
- ***Liability issues***						
- ***Short-term focus in disaster management***						
- ***Lack of resources***						
- ***Lack of political leadership***						
- ***Partnerships with other agents***						
Business & development industry						
- ***Lack of incentives to take further action***						
- ***Short-term focus on development projects***						
- ***The limited availability of resilience-related products within the market***						
Planning & design professionals planning & design professionals						
- ***Planner's lack of understanding of climate change***						
- ***Political influence on planning***						
Universities & schools						
- ***Educating communities and planners***						
- ***Communicating the science of climate change and its impacts***						
- ***Divesting investment from resource companies***						
Financial institutions						
- ***Influence on investment***						
- ***The potential of divestment programs***						
Non-government organisations						
Raising community awareness						
Urban institutions						
Policies						
- ***Higher level policy provisions & interventions***						
- ***Integration between different policies at various scales***						
- ***Incorporation of resilience and adaptation as planning concepts***						
Funding						
- ***The focus on reconstruction rather than mitigation***						
- ***The high cost of resilience upgrading***						
Local government's risk management approach						
- ***The level of acceptable risks***						
- ***Defend or retreat strategies***						
Insurance						
- ***The affordability of insurance***						
- ***The potential to encourage development in high-risk areas***						
Urban systems						
Built environment and urban settlements						
- ***The historical development of cities***						
- ***Planning and design provisions***						
Infrastructure						
- ***Key services***						
- ***Mitigation infrastructure***						
- ***Transport***						
Ecosystem services						
- ***Urban green space***						

Development on Gold Coast flood plain to have lifeboats, emergency food

July 19 2013

Kim Stephens

A Gold Coast developer will have to provide two lifeboats, a helipad, a three day food supply and a tractor at a residential estate it plans to build due to concerns over its placement on a flood plain.

The unusual conditions are expected to be imposed next week by Gold Coast City Council, which it says is unable to prevent the development.

Gold Coast City Council plans to force a developer building on a flood plain to provide two lifeboats, a helipad, a three day food supply and a tractor which can be kept at the site.

Fig. 3. Development on high-risk land on the Gold Coast (Stephens, 2013), screenshot by authors.

The last major flooding event on the Gold Coast dates back to 1974 when the city was much less developed and most of its current residents were elsewhere. Comparatively the Sunshine Coast has experienced climate events more frequently and was hit by the 2011 and 2013 Queensland Floods. This can explain the greater level of community activism and engagement on the Sunshine Coast and a more detailed focus of the local government policy on building resilience (Torabi et al., 2017a).

The majority of the interviewees discussed the implications of lack of risk awareness on property values which usually tend to return back to normal soon after a disaster occurs (e.g. the Brisbane floods 2011). A council planner (R22) explained that:

> "…at the moment, there is actually [an] inverse correlation to degree of risk and property value. So, these canal estates and stuff there, continuing to increase in value […] because that land is limited in supply it is always in high demand […] but there must come [a] time in that equilibrium where people go 'actually that is a very dangerous investment for me, both in terms of my asset and physically'. But we haven't reached that place, that conversation."

Some interviewees also pointed to the loss of adaptation knowledge over time as a result of the lack of experience of disasters and the transient nature of communities. A council engineer (R10) exemplified with old Queenslander type housing that was built on stumps to avoid flooding and noted: "When the city grows really really quickly and whole lot of new people move in you lose that knowledge […] People start to build in underneath their house […] they are actually reducing the resilience that once was there". This is particularly an issue in coastal tourism cities (Torabi, Dedekorkut-Howes, & Howes, 2017b). The domestic and international visitors to coastal cities may not necessarily have the local knowledge of the risks and there are no actions in place to raise their awareness. The local population on the Gold and Sunshine Coasts is very transient with 45–46% of the residents living in a different address five years ago (ABS, 2011). Moreover, both cities have a high number of visitors especially around peak seasons. In 2014, for instance, the Gold Coast had 810,000 (nearly 1.5 times its population) international overnight visitors (Tourism and Events Queensland, 2014). The development industry and its attitudes towards climate change can potentially play an important role in adaptation (Shearer, Taygfeld, Coiacetto, Dodson, & Banhalmi-Zakar, 2013; Taylor, Harman, Heyenga, & McAllister, 2012). However, some interviewees noted that the development industry does not have enough incentives to take further action for promoting resilience. A town planning researcher (R21) criticised the rational planning model and pointed to its limitations: "it is really a float model and there is really no space for innovation or anything that is outside the business as usual". The interviewees also mentioned the short-term focus of developers on projects (build and sell) and the limited availability of alternatives to promote resilience, even if the developers decide to choose this path. The lack of any direction from financial institutions such as banks in terms of influencing investment (e.g. not funding high-risk developments) was also mentioned by one interviewee. A recent report by The Climate Institute (2016) brought the role of banks in adaptation to climate change in Australia to the forefront by discussing the sector's ability and incentive to steer the housing market and its potential financial liability for losses due to climate-related hazards.

A critical institutional tool that can provide communities and developers with access to necessary financial resources to adapt is

insurance (McAneney et al., 2013; Surminski, Bouwer, & Linnerooth-Bayer, 2016). However, insurance can also become a barrier for adaptation (Lyster, 2015) as it may promote investment in high-risk areas (O'Hare et al., 2015). In Queensland, for instance, insurance interventions by state government were found to be creating an anticipation of future government aid to cover the damage and costs of flooding (Mills et al., 2016). There is no national flood insurance scheme in Australia and insurance providers are not legally required to include flood cover in standard policies (although many do) (Biggs, 2012). General insurance policies also exclude coastal risks such as storm surges and flooding, coastal erosion, and gradual sea level rise (Insurance Council of Australia, 2016). As a result, a relatively higher socioeconomic status population living in very high-risk areas is not actually covered under normal insurance policies (The Climate Institute and Choice, 2014). While climate change is increasing the cost of insurance for these exposed settlements, it is a larger burden on lower socioeconomic communities. An NGO representative (R5) explained: "you can't have the [exposed] property with an insurance policy 40-times bigger than somebody at the hilltop perfectly safe from storm surge so they even it up. So we are all paying for these increased risks". Most council representatives acknowledged the high capacity of the insurance industry in modelling risks and underscored the importance of collaborations with local governments. However, a few respondents noted that insurance can cause maladaptation by encouraging the community to continue to live in high-risk areas, thinking that they are covered for climate-related disasters.

4.2. Incremental approaches to resilience

Many of the approaches for building resilience on the Gold Coast and the Sunshine Coast are incremental steps that focus on reactive response to the impacts of climate-related disasters in the short to medium-term. Incremental steps in building resilience such as the incorporation of a future level of risk in planning (i.e. 1-in-100 year flood levels) and upgrade of zoning regulations and building codes accordingly can be effective as they are based on current experiences and known methods and are easy to implement (EEA, 2016; Lonsdale et al., 2015). However, they are dependent on functional persistence and can lock in communities in unsustainable pathways as they may not be sufficient to deal with future change (EEA, 2016; Matyas & Pelling, 2015). The incremental resilience building in the case studies include local government actions, policies, and approach to managing risk in the short to medium-term.

One major local government policy tool for managing climate-related disasters is the level of acceptable risk. Following disaster management frameworks in the US, planning in Australia has historically adopted the 1-in-100 year event[1] as a threshold for acceptable risk. Most of the interviewees underscored the inadequacy of such a fixed approach in planning for climate change that results only in incremental improvements and some suggested adopting multiple and higher thresholds as climate change will influence the intensity, duration and/or frequency of such events (Larson, 2009). An environmental law consultant (R26) noted that: "what was the 1-in-100 is now a 1-in-20 year event […] It is a dangerous thing to be having that figure 2100 all the time. It gives the false sense of something happening way off in the future". Other researchers in the US and Australia corroborate this view (Galloway et al., 2006; Wenger, Hussey, & Pittock, 2012). Planning requirements such as minimum floor levels and setbacks on the Sunshine Coast are stricter than the Gold Coast and incorporate some storm surge and cyclone considerations (Torabi et al., 2017a). Based on the level of acceptable risk local governments make a decision to either defend existing settlements (e.g. by building seawalls) or retreat to higher land. While transformational adaptation requires a retreat response, the implications of this for large urban centres such as the Gold and the Sunshine Coasts are severe. A council engineer (R10) stated that: "For our city some of that [retreat] is a bit of a waste of time. We can't do that, we can't de-occupy these areas […] We have got 600,000 people within our coast, 36 km long. That is a huge tax base to do what is necessary to respond to climate change". Some interviewees considered retreat to be a more viable option for smaller communities, but discussed the implications of that in terms of land ownership or insurance, especially for lower socioeconomic communities which clearly lack the capacity to cope with climate-related hazards. As reported previously (see Rijke, van Herk, Zevenbergen, & Ashley, 2012) and by our interviewees, the defend strategy is viable in large cities such as the Gold Coast which have the financial capacity to pay for the construction of defence infrastructure. However, defending can undermine resilience by providing incremental short-term benefits (i.e. protection until a certain point) but becoming unaffordable in the long run due to increasing costs.

The interviewees suggested that a defence approach should be coupled with appropriate planning and design standards, supporting infrastructure, and especially resilient transport networks. Safe failure of infrastructure is critical for resilience by lowering the possibility of severe negative consequences as well as increasing recovery rates of the infrastructure (Labaka, Hernantes, & Sarriegi, 2015; Wardekker, de Jong, Knoop, & van der Sluijs, 2010). This is especially important for Australia where more than $226 billion of commercial, industrial, road and rail, and residential infrastructure is vulnerable to inundation and erosion hazards from future sea level rise (Department of Climate Change and Energy Efficiency, 2011). As discussed earlier, most of the existing high-rise buildings are built to outdated standards. Furthermore, the redevelopment requirements for new buildings are not high enough as they require habitable rooms, access, and critical infrastructure (such as electricity) to be only above the 1-in-100 year flood levels, which can be still vulnerable to greater or combined events. Nevertheless, some still have faith in engineering solutions. For example, a few interviewees (mostly council representatives) pointed to the high level of engineering involved in the construction of newer canal estates on the Gold Coast and their capacity to absorb and direct water, especially in conjunction with the city's other mitigation infrastructure such as seawalls and dams. Gold Coast's A-line seawall is its first (and last) line of defence against natural disasters. Local government representatives particularly consider the city to be reasonably resilient to a sea level rise of about 1.5 m with the seawall. However, other interviewees raised concerns about the capacity of seawalls in accommodating the increasing risks of climate-related hazards. An ecology researcher (R9) claimed that: "apparently its integrity is unknown. It's been the responsibility of private land owners to follow the guidelines. But my understanding is that the local government has never done a full check". The council has undertaken other actions such as connecting the Hinze Dam to a grid allowing for water transfer between reservoirs in dry season and raising its wall to manage flooding (Howes & Dedekorkut-Howes, 2012), however, such incremental steps are not sufficient in long-term. Based on the levels of acceptable risk both councils have also updated flooding maps, yet, their actions are still limited by lack of resources and technology. A representative from insurance industry (R37), for instance, added the difficulty of mapping overland flows: "I can name 20-30 councils right now who can give you a flood map for how riverine flooding or coastal flooding will look in the year 100 […] What they can't do is to show where it floods today". Other incremental resilience building steps by both local governments include ecosystem-based approaches such as sand nourishment and beach restoration activities that have high benefits in the short-term. A former council engineer (R3) pointed to the example of Kurrawa Park on Broadbeach (Fig. 4) which occupies the beachfront and effectively sets development back from the shoreline and noted that "if the Gold Coast had been developed like that, then we effectively wouldn't have

[1] Definition of an event (e.g. flood or storm) with 1% chance of occurring in any given year.

Fig. 4. Kurrawa Park, Broadbeach, the Gold Coast. (Courtesy of Skyepics Aerial Photography, 27 April 2017).

most of the problems we have, because everything built out there is sacrificial […] In case of a major event, it just disappears in the ocean. That is the plan".

To be effective, resilience strategies need to be appropriately articulated in decision-making. The literature points to the need for better integration of policies for effective adaptation to climate change (Howes, 2015; Urwin & Jordan, 2008) and some interviewees noted the lack of integration as an important limiting factor for building resilience. A state NGO representative (R35) discussed the lack of consideration of disaster management and evacuation in strategic land-use planning: "Generally with local government planning your parks […] are built on unusable development lands so they are normally low-lying areas that get flooded really quickly. That becomes a big problem for us in terms of where do we actually evacuate people". A few of the respondents identified varying timeframes of different policies, such as the 10-year cycle of planning schemes as opposed to shorter-term disaster management planning or long-term climate adaptation strategies, as a barrier for effective policy integration, although a former council engineer (R3) rejected this idea suggesting that those plans serve different purposes. A few local government representatives also noted the lack of a specific local government resilience strategy and emphasised the need for a better incorporation of adaptation and resilience in all relevant government policies as well as better integration between them:

> "We have got different directorates that have great recovery plans. For example, Gold Coast Water has a recovery plan [for] how to reconnect water but they are not talking about engineering services, so if the roads get washed away […] how do they get to the pumping station? So, we need to have a holistic integrated recovery strategy […] but we have all the disparate plans. […] We have got a social plan and we have got a community inclusion plan and we have got emergency response plan and we have got engineering plans and asset management plans but they don't really speak to each other."
>
> (Council representative R8)

Incorporation of adaptation and resilience in policy goals and objectives can also be a means of achieving positive outcomes and creating room for learning and innovation (Friend et al., 2014; Kok & De Coninck, 2007; Shaw & Theobald, 2011). Through a holistic review of relevant local plans and policies of the two cases we found a higher level of focus on resilience on the Sunshine Coast but in general integration between policies was limited in both cities (Torabi et al., 2017a). A state government official (R32) noted the lack of a definition and incorporation of resilience into policies: some consider it synonymous with physical strengthening of buildings and reducing vulnerability while others focus on social aspects and community empowerment. A few council planners and engineers also highlighted the absence of use of the term "resilience" within other policies which contribute to resilience such as those relevant to community engagement or information dissemination.

4.3. A transformational approach to resilience

Transformational approaches to building resilience require considerable changes to existing responses and ways of life. Such approaches promote flexibility in the face of uncertainty, minimise the risk of lock-ins in unsustainable pathways, and explore new ways (including technology and innovation) to solve adaptation challenges that arise as a result of the previous two approaches (EEA, 2016). Transformational approaches (e.g. incorporation of multiple and higher levels of risk in planning or integration of resilience principles such as redundancy, diversity, safe failure, etc. in infrastructure planning) can bear higher initial development and planning costs but these costs decrease considerably in the long-term (EEA, 2016; Matyas & Pelling, 2015). To be effective, they also need to directly challenge the existing structures of power (Pelling, 2011). Our findings point to a limited evidence of transformational resilience in the case studies, with the existing efforts involving mainly partnerships between local government, universities, and non-government organisations to increase community resilience. Learning and education has been extensively considered as an important contributor to raising community awareness and resilience (Adger, Brooks, Bentham, Agnew, & Eriksen, 2004; Chang, Yip, van Zijll de Jong, Chaster, & Lowcock, 2015; Wamsler, Brink, & Rentala, 2011), but the role of universities and schools has been under-researched. Universities on the Gold Coast and the Sunshine Coast are contributing to research and education in the area of resilience and adaptation through different departments and institutions. The National Climate Change Adaptation Research Facility (NCCARF), for instance, is located at the Griffith University Gold Coast Campus. Some of our interviewees particularly underscored the importance of university partnerships with other organisations in promoting resilience. Evaluation of the applicability of the Baseline Resilience Indicators for Communities (Cutter et al., 2010) to the Sunshine Coast by the University of the Sunshine Coast is an example of such partnerships

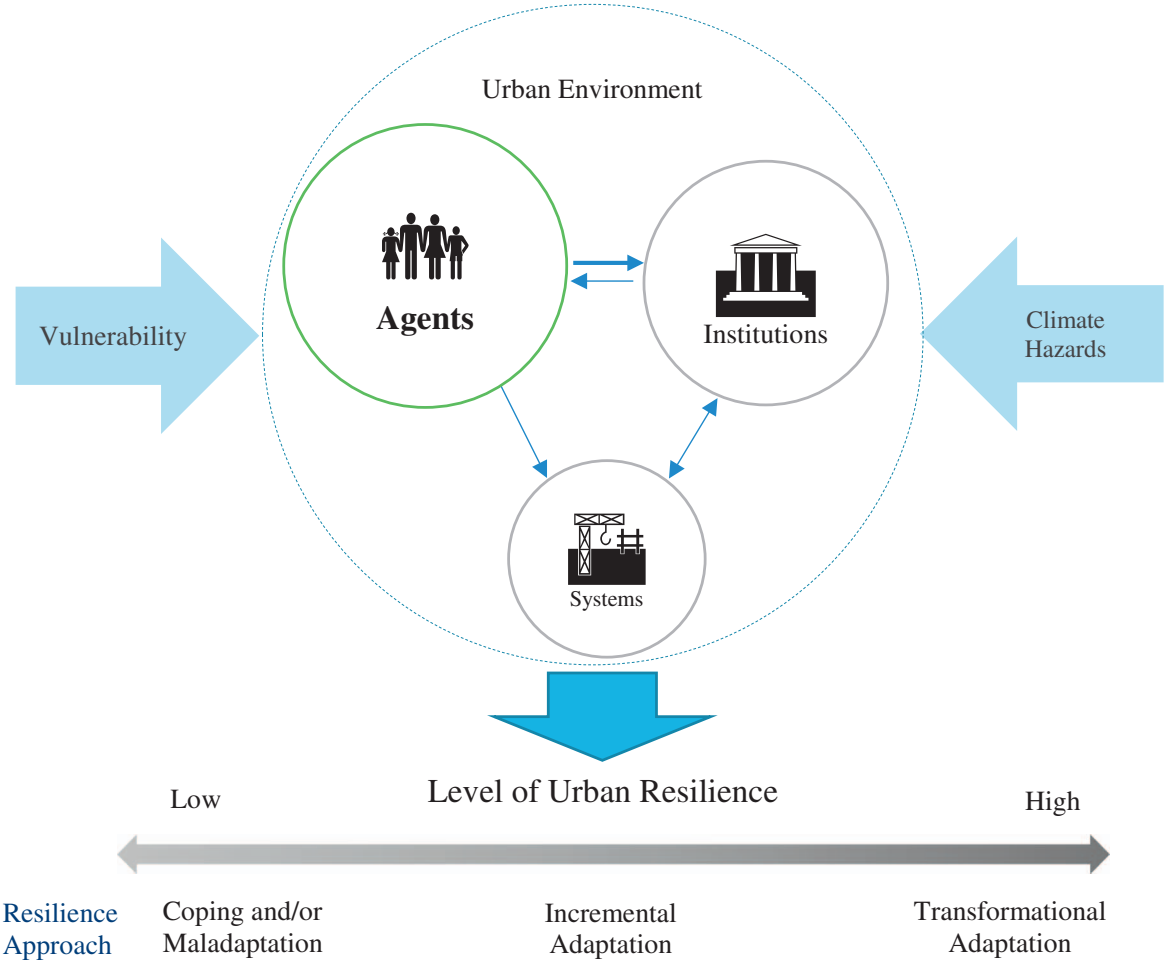

Fig. 5. The role of elements of the urban environment in level of urban resilience (the size of the circles indicates the relative importance of different elements in the cases studied).

with local councils in communicating research on community resilience (Singh-Peterson, Salmon, Goode, & Gallina, 2014). Both local governments are also using a variety of approaches to communicate the risks of disasters with the public.

5. Interactions among the elements of urban resilience

What do the two cases say about the elements of resilience in Tyler and Moench's (2012) framework? Our research illustrates the criticality of the interactions between the elements of urban resilience (agents, institutions, and systems) in influencing the resilience approach of cities. The findings suggest that while all these interactions are crucial for building resilience, urban agents and particularly the community plays a bigger role with the potential to influence the local political and planning context. Fig. 5 shows that urban agents affect the resilience of systems both directly through their choices as well as indirectly through the ways they shape the institutions such as local government policies. The interaction between urban agents, institutions, and systems in return shapes the resilience approach in planning (i.e. coping, incremental adaptation, and transformational adaptation) and influences the level of urban resilience and the different approaches to building it. The interactions in our case studies limited the level of resilience towards the lower end of the spectrum.

The interviewees identified the main agents of urban resilience as the community, local government, business and development industry, planning and design professionals, universities and schools, and financial institutions. The attitude of agents shapes the local planning and policy environment (institutions). Community's desire to live close to water exacerbates the pressure to develop low-lying waterfront land and combined with a lack of awareness/acceptance of risks results in maladaptation. A council engineer (R10) explained: “Things [developments] get more intense more quickly, everyone wants that view. Everyone wants that breeze, there is a lot of competition”. The Gold Coast and the Sunshine Coast have the highest number of properties across Queensland (85,776 and 32,605 respectively) that are located within 3 km of the shoreline on highly exposed land that is less than 6 m above mean sea levels (Department of Community Safety, 2011). The desire of the community and financial interest and political power of developers to provide the waterfront property put pressure on local governments to continue developing low-lying land. On the Gold Coast, for instance, raising the level of the Hinze Dam by the local council was followed by pressure from the community and the developers for the council to reduce the minimum flood planning requirements. However, as another key agent, the local council resisted by demonstrating that reducing such planning standards can in the long run make them more vulnerable to floods (Mirfenderesk et al., 2014). A planning consultant (R14) claimed that “the reality is that developers won't take the steps themselves, unless they are told to do so. It needs to be driven by regulation or insurance”. An architect on the Gold Coast (R4) pointed to the role of other agents such as financial institutions in shaping the attitudes of the development industry, the community, and relevant institutional tools and suggested that:

> “the insurance people are going to determine where development occurs or doesn't occur because it will become unviable for some property owners to maintain properties […] whereas local councils don't have the courage to say that ‘sorry you are just in an area

which is just not going to be feasible for redevelopment, we are not going to protect it.'"

He also observed that: "The banks have huge influence on where to spend money or how big we spend money, the size of units" and noted their potential for adaptation via divestment programs and more ethical investment. Planning and design professionals can also influence the actions taken by the development industry (Hamin & Gurran, 2009, Tidball & Krasny, 2011). Some interviewees observed a lack of focus and an understanding of climate change in planners and architects, which can undermine a long-term focus on resilience. In Australia planning educators require more training, resources, and experience on climate change (Lyth, Nichols, & Tilbury, 2007). A survey of planners in Australia (Hurlimann, 2009) identified gaps in regard to climate change and water management. The interviewees also pointed to the inherent political nature of planning. A coastal engineer (R15) remarked that: "They [planners] are hamstrung too, because they need political will to take action, even for next year". Many interviewees also remarked on the former deputy premier's 2014 directive to the Moreton Bay Regional Council to remove "any assumption about a theoretical projected sea level rise from all and any provision of the [planning] scheme" (Solomons & Willacy, 2014), which undermines adaptation even if the planners want to take more progressive actions.

Ultimately, local governments as the key agents with regulatory powers have the capacity to facilitate local adaptation actions and can play a critical role in building urban resilience (Hoppe, van den Berg, & Coenen, 2014; IPCC, 2014; United Nations Framework Convention on Climate Change [UNFCCC], 2007). However, they are influenced by the national, state, and local political climate and particularly the community. On the Sunshine Coast for instance Yandina Creek, an area of manmade wetlands that was initially created as a result of floodgate failure in Maroochy River and later became home to critically endangered wildlife, was considered "not worth conservation" by all levels of government and was planned to be drained for development, despite its high biodiversity value (Roberts, 2017) and its great potential as an ecosystem-based approach to store flood waters (Pickett et al., 2013; Wamsler, 2015; World Bank, 2010). Other examples include the Planning and Environment Court of Queensland overturning local government decisions and allowing development in high-risk areas (Bedo, 2013). The requirement of development to be built higher than the 1-in-100 year flood levels has only short-term incremental benefits as the buildings do not have flood free access. As a council representative (R8) observed: "We compromise [planning] a lot during the development process and during the approval process and even if council holds out […] it will go to court and then the courts will make an arbitrary decision around what is permissible."

The presence of committed and empowered individuals (Hoppe et al., 2014; Zahran, Brody, Vedlitz, Grover, & Miller, 2008) and the existence of green political activity at all levels of government (Howes, 2005; Hultquist, Wood, & Romsdahl, 2015) is considered to be important in shaping local government attitude and the local policy context. Our respondents mostly underscored the lack of political leadership at all levels, particularly local. As a local journalist (R20) stated "You don't get a science argument in response to concerns raised about the impacts of nature […] you get an economic argument, and the economic argument is always 'we need jobs'". A council representative (R8) suggested "If you had a chief executive officer or a mayor who wanted to integrate those things [adaptation/resilience], it would be done". In Australia the political context for climate adaptation is in a state of flux for at least the last decade. At the state level the Queensland Government led by the Liberal National Party (LNP) withdrew from climate change policies after the 2012 elections (Howes & Dedekorkut-Howes, 2016), while the subsequent Labor government (January 2015) has taken some policy initiatives to bring back the focus on climate change. The 2012 local government elections also instigated a divergence on climate policy of the two cities. Under the leadership of its LNP-backed mayor and his pro-development policies (see All That Glitters, 2017), City of Gold Coast disengaged from action on climate change completely while Sunshine Coast Council continued to develop its climate change-related policies. The Sunshine Coast has historically been a centre for pro-environment politics with the Greens vote increasing steadily in this region over the last three state elections (Raue, 2015), which can explain its relatively higher level of resilience policy integration (Torabi et al., 2017a). In contrast, Gold Coast politics has historically been pro-development (Bosman, Dedekorkut-Howes, & Leach, 2016). Some interviewees found the three-year election cycle[2] too short for local leaders to accommodate climate change responses particularly in the absence of community support. In pro-development communities, leaders' fear of not being re-elected the next term takes over. Local governments are also reluctant to scare the community. A representative from the insurance industry (R37) summarised the resulting inconsistencies:

> "You have some local governments that are incorporating a sea level rise measure in their developments. Travelling in your car for 20 minutes to the next local government area you will find that they don't […] This variability in the responses doesn't give a lot of comfort that it has been tackled in a consistent way right across the country."

Regarding main institutions important for building resilience, the interviewees discussed the importance of policies, funding, local government's risk management approach, and insurance. Institutions (e.g. planning policies) shape resilience of urban systems by regulating the built environment, key infrastructure, and ecosystem services. Institutions can also shape agents' behaviour to some extent. Higher level policies (such as those relevant to acquisition of part of a person's land) can limit local governments as suggested by a council engineer (R17): "injurious affection can have detrimental impacts on good planning so they stop planners from being able to exercise their best judgement". Several interviewees also mentioned planning shortcuts of state government such as the Priority Development Area (PDA) provisions through which they can enable development in high-risk areas such as the new Maroochydore City Centre PDA on the Sunshine Coast (Hoffman, 2012) (Fig. 6). At the local level, institutional tools such as flood maps are critical in communication of climate risks to the public. However, the attitude of the agents, particularly the community's lack of acceptance of risks and local leaders' fear of not being elected, has once again been a barrier to effective implementation of these tools. On the Sunshine Coast for instance, the release of updated flood maps (with incorporation of future risk as recommended by the QFCI) has resulted in community backlash due to its implications on property sales and insurance premiums (Sundstrom, 2013). This puts a lot of pressure on local governments that are trying to find a balance between addressing such community concerns and avoiding exposing the community and the council to future risks and legal action (Weston, 2014).

The systems that interviewees found important for urban resilience included the built environment and urban settlements, infrastructure, and urban green space. Systems can shape the local institutional context. The path dependencies caused by historical development of coastal cities on low-lying land can require engineering solutions to deal with risks. A council planner (R22) noted that:

> "Every time there is a new planning scheme, 90% of development in the place is already in play, so that new scheme is only going to deal with generally 10%. So sure you might be making buildings more resilient over time but you have got to deal with the [setting] you have laid from the past."

[2] Queensland now has four-year parliamentary terms as a result of a March 2016 referendum (Electoral Commission of Queensland, 2016), but the federal elections remain on a three-year cycle.

Fig. 6. The Maroochydore City Centre PDA on the Sunshine Coast is located at the site of the golf course.
(Courtesy of Skyepics Aerial Photography, 12 January 2016).

The concentration of urban development along the coast in Australia exacerbates exposure (Chen & Mcaneney, 2006). The majority of the interviewees associated higher levels of resilience with geographical location of settlements on higher land and pointed to the differences in the historical development of the Gold Coast and the Sunshine Coast. While the Gold Coast is in very close proximity to water and it has historically "engineered the floodplain" by draining and building over wetlands (Dedekorkut-Howes & Mayere, 2016), development on the Sunshine Coast has been relatively set back from the coast. However, as Table 2 has shown, both cities are struggling with taking transformative approaches to adaptation. At the moment both local governments are relying on a "shelter-in-place" strategy for managing disasters in urban areas mainly because of the vulnerability of existing transport networks and the complexities of evacuation. Research has shown that an evacuation strategy as opposed to shelter-in-place can exacerbate the morbidity/mortality rates especially for more vulnerable land-uses such as aged care facilities and nursing homes (Dosa et al., 2008, 2012), which is an important consideration for the Gold and Sunshine Coasts which both have large proportions of older population (ABS, 2011). However, with the increasing risks of climate-related disasters short term actions need to be integrated with long-term strategies to avoid development of high-risk land.

6. Conclusions

This research has demonstrated some of the main impediments and pathways to building meaningful resilience in coastal cities. While the findings are discussed in the context of two Australian cities, they reflect the challenges faced by many coastal cities around the world with regards to increasing risks of climate change. Drawing from the ambiguity around the meaning of the concept of resilience and how it can be translated to cities, the research explored the role of agents, institutions, and systems (Tyler & Moench, 2012) in contributing to resilience. It also examined the drivers and barriers to the three main approaches to building urban resilience (coping, incremental adaptation, and transformational adaptation). Overall, our research found that approaches to building resilience are currently dominated by merely coping with existing risks and continuing business as usual or taking incremental steps to dealing with particular risks in the short to medium-term while ignoring long-term impacts. While all urban agents, institutions, and systems play a role in this outcome, our findings brought the influence of the agents on institutions to the forefront for transformational resilience. Urban agents have the potential capacity to influence the institutional context to a great degree. Local communities in many coastal cities have a strong preference for waterfront living and resist any efforts to stop them. This preference drives the development industry and puts pressure on local governments. Local governments are bound by policy and politics which tend to reflect communities' wants. The waterfront living pattern and the incremental steps undertaken by local governments to protect these settlements lead to maladaptation by unjustly burdening the most vulnerable groups of the community by increasing the cost of protection for everyone. Although the existing path dependencies and maladaptation in coastal cities are socially constructed, building resilience for meaningful adaptation to climate change goes far beyond the reconstruction of such structures and requires a more transformative approach (Barnett et al., 2015). This does not necessarily dismiss the value of coping and incremental approaches. On the contrary, transformational adaptation builds on the advantages of such known approaches and further develops a continuous shared learning and innovative process in adaptation (Kates, Travis, & Wilbanks., 2012; Tschakert & Dietrich, 2010; Pelling, 2011; Wiseman, Williamson, & Fritze, 2010). Educating and engagement of the key agents including key financial institutions, developers, planning and design professionals, and most importantly transparent and appropriate disclosure of climate risk to the communities are critical first steps. The aim should be creating a shared understanding of the value of resilience and investment in it in a changing climate. Such an approach entails reconfiguration of current institutional tools such as planning policies, funding, and insurance to promote resilience, affordability, and justice and needs to be supported by political will and leadership from all levels of government. The existing literature acknowledges the political nature of planning and requires a fundamental transformation to accommodate learning and change (Hurlimann & March, 2012; Storbjörk & Hjerpe, 2014) but there are significant barriers (Kettle & Dow, 2015; Larsen et al., 2012; Picketts, Curry, & Rapaport, 2012). Particularly, despite the increasing emphasis on resilience urban planning is being criticised for overlooking issues of justice and fairness (Davoudi et al., 2012; Fainstein, 2009; Jarvie & Friend, 2016). To overcome this shortcoming, urban planning needs to broaden its focus beyond economic development to include considerations of all urban elements. Uncertainty needs to be critically embedded within strategic planning through explicit and reflexive consideration of the existing barriers and long-term impacts of climate change (Malekpour, Brown, de Haan, & Wong, 2017; Matyas & Pelling, 2015). Planners have a great

responsibility for initiating this change. Aside from testing the ability of cities to respond to internal and external disturbances, resilience is also an important test for the capacity of the planning system and city's planners to be innovative (Westhoff, 2016). Planning for resilience requires a well-integrated and forward-thinking approach to shift the focus from traditional notions of precaution (Johnson, 2012) to a more adaptive and proactive management of the urban system and all its aspects and elements in the face of internal and external disturbances. More effective engagement of planners in adaptation can influence attitudes and behaviour of other agents, especially the community and the development industry, and contribute to resilience.

Appendix A. List of interviewees

Respondent	Gold Coast	Respondent	Sunshine Coast	Respondent	Other
1	Planning researcher	16	Planning researcher	26	Environmental law consultant
2	Property consultant	17	Local government engineer	27	Planning consultant
3	Former local government engineer	18	Local government planner	28	Environment consultant
4	Architect	19	Local government disaster manager	29	Intergovernmental forum
5	Non-government organisation	20	Journalist	30	Engineering consultant
6	Non-government organisation	21	Planning researcher	31	State government environmental planning
7	Local government architect	22	Local government planner	32	State government disaster manager
8	Local government officer	23	Planning researcher	33	State authority
9	Ecology researcher	24	Property development industry	34	State authority
10	Local government engineer	25	Planning consultant	35	NGO
11	Local government engineer			36	State government coastal engineer
12	Local government planner			37	Insurance industry
13	Environmental scientist				
14	Planning consultant				
15	Coastal engineering researcher				

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